

Integrated Information Infrastructure Applications

Background and Rationale

As emphasized in the Administration's "Agenda for Action" white paper, perhaps the most significant technological shift in this decade will be in the way people deal with information, from the personal level, business level, and the government level. Information has become one of the nation's most critical economic resources, for service industries as well as manufacturing, for economic as well as national security. In an era of global markets and global competition, the technologies to create, manipulate, manage and use information are of strategic importance for the United States. Those technologies will help U.S. businesses remain competitive and create challenging, high-paying jobs. They also will fuel economic growth which, in turn, will generate a steadily-increasing standard of living for all Americans. For all these same reasons, these technologies will also be of strategic importance in maintaining the Laboratory's ability to be both stewards and providers of advanced weapon technologies.

Technologically, the NII consists of basically of three general components: hardware infrastructure (primarily the network), software infrastructure (primarily software services), and the applications (working interoperably and over the network). The NII will consist of the integrated working together of these components for everyone's benefit. *"Every component of the information infrastructure must be developed and integrated if America is to capture the promise of the Information Age"*

The administration is committed to working with private industry to establish the basic principles of the NII, and to use regulation to encourage private sector investment, technological innovation, to ensure universal service, to encourage interoperability, and to ensure information security and trustworthiness.

The strategy we are choosing to meet this technological challenge is to develop an integrated approach to applying the information technology to science and society. This includes selecting a suite of applications, for which common infrastructure solutions can be found. This allows, for example, a solution of problem of importance to health-care to rapidly impact problems in industrial manufacturing, or even gas and oil exploration and production. This involves not only finding common solutions but in tightly coupling the research and development and information management so that these new tools can be more rapidly deployed both in the laboratory and by industry, itself. Further information on this project and its approach can be found on the World Wide Web in URL:

"<http://www.acl.lanl.gov/sunrise/sunrise.html>".

Program development opportunity

The four components of the Federal NII program include

- Information Access to improve public access to government information by allowing agencies to make such information available electronically ,
- National Performance Review to use information technology investments to move towards *Electronic Government*,
- High Performance Computing and Communications Program,
- and Service Delivery to use information technology to deliver services such as loans, benefits, and grants directly to the public.

The Federal High Performance Computing and Communications program has allowed DOE to continue its leadership in this core area, long supported by the weapons program. This has resulted in a flag ship effort in the national high performance computing arena at Los Alamos. Because DOE is getting no additional funds in FY94 or FY95 for NII activities, the DOE's leadership position is eroding rapidly. In FY95 the President's budget contains over \$3 billion for NII activity which we are aggressively pursuing. This includes requesting the inclusion of \$50M into the federal budget for the DOE in FY95. The linkage of these various components is crucial to the economic competitiveness of the nation and to the actual use of high-performance computing in its various forms throughout industry. As is clear from the emphasis of the national program, the ability to deal with large amounts of distributed information intelligently and efficiently will be fundamental to not only the success of High Performance Computing but to the societal infrastructure as a whole later in this decade. The potential revenue to the laboratory in this area alone is well in excess of \$10 million/year and can leverage at least 10 times that in related efforts in programs that use the infrastructure tools.

By developing an integrated approach to the Information Infrastructure and linking High Performance Computing with commodity software and hardware tools, we have an opportunity not only for Federal funding but also working directly with industry to assist them in their large data management and analysis problems. This is possible because of our unique position in understanding the computational algorithms and integration technology.

Connection to strategic directions and laboratory goals

The Laboratory has a goal to sustain its world-class strength in High Performance Computing and to work closely with industry on a variety of areas including materials manufacturing and a variety of others. We have identified several industrial partners which are working with us to advance the state of the art in their field. These include manufacturing companies like Gatan that market Tunneling Electron Microscope equipment, to Xerox who is seeking new ways of developing Xerographic engines, to Adobe and HaL who are developing advanced tools for electronic publishing and network navigation, to the National Jewish Center for Immunology and Respiratory Medicine, to the Dept of Commerce.

R&D approach and likelihood of project success

The HIII project was started in FY94 to enable the laboratory to take an aggressive stance in NII and provide a strong R&D base for obtaining NII funds from various government agencies and even from U.S. industry.

In order to achieve this ,we have set the following three objectives:

- To develop common information-enabling tools for advanced scientific research and its application to industry
- To enhance the capabilities of important research programs at the Laboratory
- To define a new way of collaboration between computer science and scientific research and development.

The basic paradigm being developed involves a document-centric user interface which will allow arbitrary object support including embedded applications, multimedia video/voice fragments and links to a wide information space.

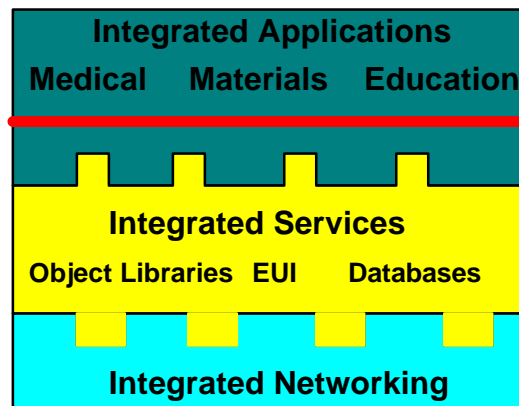
We are developing an "information kiosk or portal" based on an ATM network so that all the participants can exchange, "publish", or interact on applications and data. This will function on heterogeneous platforms, provide for constrained access to data through security mechanisms, and be extensible. The data-mining technology will include the ability to quickly browse large complex image databases with various feature extraction capabilities, provide advanced, selective, compression algorithms, and the ability to merge and purge large complex data sets.

The focus is on real scale problems, reflecting our belief that only experience with real problems encompassing huge data sets will facilitate true progress. Dealing exclusively with toy problems is as likely to mislead as it is to inform. For example, trivial issues like name fusion, can become critical with huge data sets. Therefore, our focus will be on developing prototype tools that can be tested in real-sized testbeds.

We believe the benefits will be to the laboratory as a whole in helping define the way research will be done in the future, in enhancing the competitiveness of laboratory research programs, and in enhancing the nation's ability to use advanced information technologies for applications of importance to industry.

We are taking an integrated approach in which several applications in disparate areas are developed simultaneously. This is to avoid vertical solutions applicable to only one domain, but rather to raise the level of commonality and interoperability to a new level. The identified application areas are at the core of the NII and include telemedicine with the potential for substantial change in the way health care is carried out, materials modeling and analysis which can change the way materials data is analyzed and dispersed in the manufacturing community, transportation [analysis] which has the potential to change the way traffic information is utilized and understood to improve the functioning of the cities, and finally education in which what is being taught as well as the methods of teaching are currently under rapid change. These four areas represent a sufficient diversity of applications to characterize the NII and to provide an excellent foundation for determining the common infrastructure required.

The integration of applications and their dependency on integrated services and networking is show below.



We envision the use of the Sunrise environment by novice and expert users who wish to explore the NII and/or collaborate in research. The environment will provide the users with an interrelated set of tools which will enhance their interaction with a domain of knowledge. The interaction of the tools and the knowledge domains might produce a medical diagnostic system, an environment for materials development and design, or a classroom learning situation. The tools will facilitate the formulation of a problem, it's solution, the interpretation of results and the publishing of those results. In support of these tasks, the tools will provide mechanisms to query the range of information sources on the NII, to consult with experts in a knowledge domain, and to collaborate with co-workers in formulating and solving problems. The envisioned toolset has a number of components:

- A journalling facility, similar to a scientist's log book, to track the individual's research progress including the data sets accessed, the results of data analysis, the individual's interpretation of those results, and monitoring the individual's interactions with others. [Note that there are privacy implications here]. The log would be secure, and would provide authenticated time stamps which might be used to validate rights of first discovery of some idea. It will utilize object encapsulation to deal with multiple problems, patients, categories, etc. Appointments, meetings, etc. would be accommodated.

- An interface to experimental equipment in order to initiate, monitor and analyze an experiment connected over the network to the system. Similar functionality for initiating detailed computational simulations on remote supercomputers will also be provided.
- A remote data access and display capability which interacts with various distributed databases included OODB's over the network. It will provide a complex querying interface supporting text, multi-spectral images, and digital video attributes (perhaps combining with the results of previous queries in a hierarchical manner). It provides for the publishing of data by the user and the ability to "purchase" remote data either by value or by reference.
- A digital document repository which facilitates the retrieval and publishing of research documents. This might be just a variation on the more general data access tool. These documents might be hypermedia tours of selected parts of the individual's logbook.
- An accountant which will monitor the cost or potential cost of actions and invoke an authorization process under certain conditions and provide rapid feedback on the actual cost of the actions. (This is a variant of a work-flow capability) Such an authorization might be triggered when a remote data request accesses commercially billed information, which might only be advertised by attributes. The actual data in that case might be the part that costs.
- A toolbox of analysis modules which provides processing of data to facilitate the actual research.
- A facility that can provide a range of help from concise command summaries all the way to live telecollaboration with paid consultants
- User annotations across the entire domain would be supported. These also could be made available to collaborators or published more widely. We envision native viewers of much of the data with more sophisticated domain-specific analysis tools being invoked as needed.

The set of applications we have chosen to develop this framework for, based on relevance to the NII and the Laboratory's strategic directions, are: Telemedicine Applications, Materials Analysis, Transportation, and Education. These are described below.

Medical Applications

Pat Kelly, Mike Cannon, C-3; Dick Phillips, C-5 - \$525K

The National Information Infrastructure (NII) will have a profound effect on the way in which medical data is utilized. Not only will a patient's medical history be immediately available to a physician anywhere in the country within seconds, but this history will contain text (physician notes from every office visit), numerical data (height, weight, blood pressure), digitally recorded signals (erratic heart sounds, EKG traces), and digital imagery (photographs, x-rays, MRI scans). Doctors will be able to work more effectively, and the massive on-line databases of medical data will provide researchers with exciting new resources of information.

As part of our telemedicine efforts, we are collaborating with radiologists at the National Jewish Center for Immunology and Respiratory Medicine (see reference below). There are many different aspects to telemedicine:

Multimedia Data Management

We are developing a prototype software environment for a physician where all relevant information is available and easily manipulated. This system will display and analyze imagery, manage patient records, provide easy data entry, and facilitate report generation. Transparent access to information located anywhere on the massive *information superhighway* will give doctors great flexibility in their work. Here is an example of the telemedical user interface

GAIN: application "drugOgram" of library "rip"

File Edit View Properties Create Position Special Help

LEGEND: INH = Isoniazid, RIF = Rifampin, PZA = Pyrazinamide, EMB = Ethambutol, SM = Streptomycin, KM = Kanamycin, AK = Amikacin, CM = Clofazimine, ETA = Ethionamide, CS = Clofazimine, PAS = Para-aminosalicylic Acid, CF = Clofazimine, CIPRO = Ciprofloxacin, OF = Ofloxacin, CLARI = Clarithromycin, AZ = Azithromycin.

ANTI-MYCOBACTERIAL DRUG HISTORY

8-21-42

PATIENT HX: 48 yo white male with persis accompanied by fevers, high pk/hrs), remote (20 yrs ago)

DATE: 12/90 9/91

BACTERIOLOGY:

X-RAY:

INH

RIF

PZA

EMB

SM

KM

AK

CM

ETA

CS

PAS

CF

CIPRO

OF

CLARI

AZ

ORGANISMID: M. fortuitum/chelonae

DRUG SUSCEPTIBILITY: clari, cipro, imipen., AK

DRUG RESISTANCE: eryth., cefox., TMP-SMX

1/92 1/93 9/93

Open lung biopsy

incr. mass size

NJC Clinic

NJC inpatient

decr. hearing

IFN-gamma therapy started at NIH

page: 1 of 3 at 100%

Interactive Collaboration

Using programs developed to take advantage of the NII, doctors from remote locations will be able to interact with one another from their computer terminals. They will not only be able to hear one another and see one another, but also interactively work with medical imagery on their computer screens. A doctor located remotely in a small town will be able to consult a specialized radiologist in New York City through this system, receiving immediate feedback to questions. Specialists working from a single location will have patients located all over the globe.

Data Compression & Transmission

Even with the new bandwidth that the *information superhighway* promises, data compression for transmission and storage purposes will still be necessary. It will become even more important as we develop mobile analysis stations for remote applications (such as search and rescue operations or battlefield medicine).

Remote Data Storage and Retrieval

One of the great advantages of having all hospitals and medical research facilities tied together electronically is that a new wealth of information will be available to researchers. Medical studies will be performed on huge segments of the population instead of small groups of local patients. Large, distributed databases designed to facilitate these studies will contain not only traditional patient record information, but also digital imagery as well other non-textual data. With all of this data available on-line, the opportunity exists for automated data mining methods to identify new health trends for the general

population, and possibly identify new diseases earlier than currently possible. This has been used effectively to date in content-based retrieval of pulmonary CT imagery

Automated Data Analysis

As new databases are developed to store mountains of information, new methods for mining huge volumes of data will become increasingly important. Tools will be needed for analyzing text, imagery, 1-D signals, and other numerical information (LDL & HDL cholesterol counts, blood pressure, body temperature, etc.) Examples include the following

- Quantitative Analysis of LAM Disease
- Quantitative Analysis of Scleroderma
- Quantitative Analysis of Near Fatal Asthma
- Analysis of Digital Mammography

Project Goals:

- Develop methods for describing and comparing digital imagery for use in image browsing applications.
- Apply segmentation/comparison techniques to pulmonary CT data. This is currently known as part of the "medical application" for Sunrise.
- Develop efficient methods for "indexing" digital imagery in a similar fashion to the way keywords are used to index databases of textual data.
- Develop methods for efficiently storing and transmitting large images. This includes aspects of data compression as well as progressive transmission and image browsing.

General Tasks:

- Continue to develop methods of signature generation and signature matching for image retrieval purposes.
- Build an on-line, "interactive" paper in Mosaic from our LA-UR describing IBROWSE. This will obviously be updated periodically during the course of this project.
- Continue with feature selection and image comparison for the image retrieval aspect of the medical application.
- Develop a complete approach to the overall segmentation of pulmonary CT imagery. This is the basis for Quantitative Radiography.
- Develop methods for mapping between images; show areas where matches were indicated by CANDID. This will specifically indicate the areas that provided "similarity" between two images.
- Establish a growing on-line database of CT imagery for use by NJC, and eventually others.
- Develop methods for indexing into large images, similar to keyword indexing for textual data.
- Apply CANDID to 1-D signal retrieval (speaker identification)?
- Extend compression and multiresolution browsing capabilities to multispectral imagery.

Schedule for Deliverables

March, 1994

LA-UR describing current CANDID research (i.e. image retrieval by content).

April, 1994

Deliver prototype MRSID package (Multiresolution Seamless Image Database) for browsing huge images at multiple resolutions.

June, 1994

First version of the "hypertext" on-line Mosaic article describing current IBROWSE research.

August, 1994

Deliver Motif version of MRSID browser.

December, 1994

Deliver prototype Khoros-based system that compares and retrieves digital imagery, and also indicates which specific areas in the images generated the most significant match as indicated by CANDID.

November/December, 1994

First operational on-line database for CT imagery to be in place for use by NJC. [This also depends on the ability to have a communications link in place]

June, 1995

Deliver integrated system for automated segmentation of pulmonary CT data to the Sunrise project.

June, 1995

Deliver prototype indexing system for large databases of digital imagery. Again, most likely for satellite imagery. Combine MRSID with CANDID for this application (i.e. merge database image search capabilities with multiresolution browser).

September, 1995

Make on-line version of medical application available outside of LANL.

Materials Analysis

Rich Lesar, CMS; Niels Jensen, T-11 - \$200K

As in many fields, materials science is undergoing an information revolution. The development of experimental technologies that probe materials properties on extremely small scales results in tremendous amounts of data. New approaches to modeling materials systems using advanced computational methods also lead to data on an unprecedented scale. One of the great challenges facing materials science is to learn how to maximize the amount of useful information extracted from these data. The main goal of this project, however, is not just to develop new ways of analyzing experimental data, but also to create a new paradigm for sharing information between experimentalists, theorists, and computational scientists.

Examples of the new experimental methods available in materials science are the variety of microscopy tools, such as transmission-electron microscopy (TEM), atomic-force microscopy, etc. TEM, for example, has advanced considerably over the past few years with the best instruments now reaching accuracies on the order of an angstrom. That kind of data provides atomic-level images of a large variety of materials structures. How to best extract information from those images involves both identification of important features as well as creating databases to better access the images.

The key to understanding mechanical and transport properties of various materials is by correctly analyzing the distribution of their spatial components. The problem in carrying out such analysis usually lies in reducing the enormously detailed microstructural information to give the relevant characteristics of the structure. This is typically done by direct numerical analysis, e.g. Fourier analysis, of the complete

data set or simply 'by eye', identifying relevant characteristics of the data. Both these methods are extremely resource consuming. The first is usually a heavy, if not impossible, load for a computer, since the large range of spatial scales, from microscopic to macroscopic dimensions, are fully represented. The second is usually fast when data are presented as two dimensional pictures, but this is of course not always true. Further, the 'by eye' method relies on data presented in a convenient visual manner, which may enhance some features and suppress others.

We are implementing a new coarse-graining procedure that can be controlled by a set of parameters (Physical Review E Vol.48 p.4492 (1993)). These parameters can be calibrated to generate characteristics at any spatial scale based on a heavily reduced data set. The coarse graining from the detailed data set is generated by an integral transformation with a kernel giving the nature of coarse graining. The resulting data set is then stripped of microscopic information such as individual atom positions, but maintains information about mesoscopic structures such as grain boundaries, dislocations, and density fluctuations. The new data set, being reduced orders of magnitudes, can then be the basis of numerical analysis, searching for specific features.

The critical point in the above mentioned procedure is to calibrate the parameters of the kernel in the initial integral transformation. Since the basic idea is to eliminate excess information from the full data set, we must be careful eliminating just that. This suggests that we must decide in advance almost exactly what information is of interest to keep in certain data sets. For example, we would need to make a certain kernel function for analyzing two dimensional Electron Microscope pictures, maintaining information about defects and density fluctuations, and make a different kernel for maintaining the same information in a reduced two- or three-dimensional data set originating from numerical simulations. Hence, we need to make not only a data bank of raw images(data sets), but also a data bank of relevant kernel functions serving different purposes.

The issues facing materials scientists do not differ greatly from those experienced in many other fields, including some being addressed by other parts of the Sunrise project. As our efforts in materials data extraction develop in the next year, we shall closely couple our project with the ongoing efforts in the IBROWSE project, the CANDID algorithm development, and the work on creating quantitative analysis tools for medical imagery. In particular, large numbers of images from TEM exist already and need characterization beyond what has been done. These images are currently in the form of photographs, which will be scanned in and put in a data base. The tools developed in the IBROWSE project will enable us to browse quickly through these large datasets. Coupling our coarse-graining algorithm into the IBROWSE tools will provide a consistent interface across the Sunrise project. The CANDID algorithm development offers the exciting prospect of being able to search our database for images with similar features, which will prove an invaluable tool for developing a sense of the common characteristics between materials. While we are taking a somewhat different approach to data extraction than those in the Digital Mammography or Quantitative Radiology projects, our goals are similar. We will work with them to compare and contrast the approaches, looking for optimal algorithms.

The issue of being able to extract information at a number of length scales is prevalent in other areas of experimental and theoretical materials science. Our long-term goal is to develop kernels for many applications and then create a program, currently called DataExtractor, based on the IBROWSE tools. The creation of the DataExtractor will be an invaluable resource for most areas of materials science.

There are two types of customers for the technologies we are developing. We have contacted one of the premier companies marketing TEM equipment and hardware, Gatan Inc., of Pleasanton, CA, about their interest in the development of quantitative analysis tools. They are extremely keen to develop a long-term partnership to develop these tools for TEM applications. They believe that the competitive edge given to them by providing quantitative analysis will increase that share.

On a broader scale, a number of software companies provide modeling and analysis tools to the materials science (and other)communities. We have a close relationship with one of these, Biosym Technologies, Inc. As their name suggests, they began as a company marketing software for the pharmaceutical industry. They have branched out to the polymer, catalysis, electronic materials, and now structural materials

arenas as well. They recognize that the kind of problems in analyzing TEM images are shared many researchers in many fields and that the types of capabilities in the DataExtractor program will have very wide applicability. They are quite interested in working with us to develop this approach for commercialization.

Presentation and Analysis of Complex Data obtained from TRANSIMS project

Doug Roberts, TSA-DO - \$200K

The TRansportation ANalysis SIMulation System is a project sponsored by the Department of Transportation. TRANSIMS is a new simulation-based analysis system intended to model architectures of advanced transportation systems. It is an entirely new approach extending beyond traditional transportation system modeling. TRANSIMS is based on bottom-up generation of system activity and behavior using detailed simulations of interacting subsystems and traveler intelligence. In this approach regional microsimulation and representation of traveler-by-traveler plans and travel execution yields emergent behavior patterns to predict transportation issues ranging from land use to air quality.

In this first year of the TRANSIMS effort, a proof-of-principle demonstration was completed that illustrated the approach's features and capabilities using an intermodal pilot study that focused on a notional, metropolitan area. The prototype study was based on an actual sample of 2,100 households in Albuquerque, New Mexico. Based in this sample, TRANSIMS synthesized 218,000 households comprising 400,000 individual travelers. While this synthesized metropolitan area is based on an actual data sample, the notional approach does not disclose confidential information regarding any specific

Two million trip plans were generated for the individual travelers over a 24-hour period based on travel requirements, network characteristics, mode availability, and an individual socio-economic cost model. Walking, private vehicle, and public transit mode selection was allowed in this demonstration, along with traveler demanded mode transfer. Individual vehicle and traveler operational characteristics were permitted and the microsimulation element of TRANSIMS executed the trip plans and aggregated the results to illustrate freeway traffic during rush periods. Based on specific emission profiles for the vehicles as mobile sources, regional air quality studies were represented.

The TRANSIMS architecture is intended to provide a new and unique tool for regional-level, micro-scale system representation that will allow unification of issues in regional transportation planning and analysis, traffic engineering, and environmental impact analysis. The results of this proof-of-principle state of the TRANSIMS project has been reviewed and evaluated the Department of Transportation officials, and a five-year development plan has been produced.

An important component in the long term is to provide a means of understanding and assimilating the data from such a simulation over long distances. In fact, this transportation simulation is only one of many such problems of importance to the nation. As part of the Sunrise project, we are developing a prototype of a remote user interface to ascertain the best means of presenting complex information taking into account the bandwidth of remote connections and the limited processing power at remote sites. This demonstration interface will provide remote TRANSIMS users with the following features:

- a graphical network browser,
- a graphical trip plan browser,
- an interactive data plotting capability, and
- an image browser.

The interface will be designed to allow the remote interface client to access data sets which will reside at LANL. Although this is not part of the TRANSIMS project, this project is anticipating needs yet to be realized by the Dept of Transportation and determining the best tools for presenting complex, discrete-event simulations which are important to a variety of industries. We anticipate that this project will utilize many of the data reduction techniques

being addressed in other parts of this proposal and will reside on a common distributed-object framework also being developed.

Sunrise Education NII Project

Pilot Multimedia Virtual Laboratory for K-12 Education

Pat Eker, C-6 - \$100K

As part of the LDRD/NII "Sunrise Project: Heterogeneous Institutionally-Integrated Information Infrastructure (or HI⁵)", we are developing and testing educational applications for the technologies being developed. C-5 has put together a multimedia server that allows for the distribution of digital video and synchronized sound to many clients simultaneously. Video and audio information is stored on the server and made accessible through a user interface. This effort is to test this technology with an educational target population.

Motivation and Goals:

Our primary goals include the following:

- To illustrate the capability and power of multimedia databases and virtual laboratories in a real world context, using real-time digital video and synchronized sound on lines.
- To develop and test a database of educational information and materials in a variety of media for selected educational research projects and topics, including a sampling of Alamos National Laboratory (LANL) historical documents and videos as well as some of the most current information and results from research being done at LANL.
- To facilitate high cognitive level learning over the Internet through student-scientist and student-student collaboration at a distance.

FY94 Tasks and Deliverables:

Tasks:

1. C-5 make multimedia server available for this pilot.
2. C-6, C-5, IS, ACL, and C-3 provide material for the server.
3. C-5 load the server with the information and make database available to users.
4. C-6 and C-5 design/revise interface to the server, ensuring that it is easy-to-learn and the roadmap for locating desired information is clear.
5. C-6 contact schools, set up demo, work with teachers, set up 486 machine with the necessary software and hardware to receive the images, set up usage monitoring software, train local student and teachers on usage, be available for consulting.
6. C-6 monitor usage.
7. C-3 visit schools at prearranged times to assist students with specific projects.
8. C-6 document project; publish.

Deliverables:

1. Demonstrated functionality of Internet accessed multimedia server for education, virtual laboratory, curricular enhancement.
2. Multimedia documentation of what students and teachers did with the new capability.
3. Assessment data from use of the new technology (i.e., evaluation report)

Proposed FY94 Schedule:

Oct. - Dec.: Tasks 1-4

Jan. - April: Tasks 5-7
May - July: Task 8

Revised FY94 Schedule:

Oct. - Dec.: Tasks 1-4
Jan. - May: Tasks 5-7
June - July: Task 8

Project Activities this Quarter :

We have completed Phase I and are currently completing Phase II of a six phase FY94 educational plan for this project to complete the tasks outlined in the original proposal. We plan to complete phases III - VI by the end of July.

Phase I Technical Design and Testing

Equipment: Workstation Needs Determination and Procurement
Multimedia Server & Novell Netware IP Software
School Test-Site I (Los Alamos High School)
Determine the teachers and students who are going to participate.
Equipment: Constraints, needs and concerns.
Topic Selection: Participant interest areas and other needs.
Implementation plan and infrastructure design.

Documentation: Gather data, observations, record.

Phase II Technical Design and Testing

Equipment: Platform Set-up and Testing - Onsite LANL
Mosaic Interface to Server: Develop basic user-friendly interface.
Target ACL Material (Video & Audio) Converted/Edited/Added to Server
Target ACL Material (Text & Audio) Created/Converted and Added to Server
Target LANL Historical Material (Text, Video, Audio) Converted/Edited/Added to
Server

School Test-Sites I and II (possibly III)
Install and test equipment in the LAHS Computer Lab.
LAHS "Core students": Learn Mosaic
Prepare activities sets for "core" students to do to create demonstrations
for other students who will be participating and for selected
classes for the participating teachers.
Other Sites: Collate information and target next proposed sites.
Meet with teachers, administrators, and technicians at other proposed
school sites.

Documentation: Gather data, observations, record.

Phase III Technical Design and Testing

Equipment: Platform Continued Testing - Onsite LANL
Mosaic/Server Interface Demo Developed
More Target ACL Material (Video, Text, Audio)
Converted/Edited and Added to Server
More Target IS Material (Video, Text, Audio)
Created/Converted/Added to Server

School Test-Sites
LAHS:
Research projects and multimedia implementation with curriculum

Orientation of teachers involved.

Selected "core" set of students trained to access and edit digital video and synchronized sound stored on the multimedia server at LANL.

"Core" students do activities sets and create multimedia presentations on selected topics for/with a teacher.

Troubleshooting instruction.

Documentation: Gather data, observations, record.

Phase IV

Technical Design and Testing

Mosaic Interface to Server: Refine and augment interface.

School Test-Sites

LAHS:

The "core" students do the presentations for students from the teacher's classes. Other selected students are trained to use the media with the help of the "core" students.

Site II (and possibly III):

Determine the teachers and students who are going to participate.

Equipment: Constraints, needs and concerns.

Topic Selection: Participant interest areas and other needs.

Equipment Installed & Tested

Documentation: Gather data, observations, record.

Phase V

Technical Design and Testing

Mosaic Interface to Server: Refine and augment interface.

Applications: Assist teachers and students in using and developing curricular applications and in exploring alternative, state-of-the-art I/O devices(e.g. PDA).

School Test-Sites

LAHS:

Virtual laboratory interaction with a scientist for a class session

"Core" students choose individual research topics and develop multimedia presentations combining LANL server and other internet resources.

LAHS and Site II (and possibly III):

Student-student collaborative research project using multimedia resources and techniques.

LANL scientists assist with specific topics.

Documentation: Gather data, observations, record.

Phase VI

Documentation: Collation and Publication of FY94 Research.

FY95 Project Goals :

In FY94 we will complete a prototype database, educational model, and technology design. We have just started to scratch the surface in the areas of educational implementation, implications, and applications for this technology. We are concentrating on refining the technologies to better serve this area of applications.

In FY95 we would like to continue research in this area, apply lessons learned, refine and enhance our database and educational model, and expand our test-site base. Our primary goals include the following:

- To further illustrate the capability and power of multimedia databases and virtual laboratories in a real world context, using real-time digital video and synchronized sound on the internet via high-speed lines.
- To expand and test the database of educational information and materials in a variety of media for selected educational research projects and topics,.
- To develop a well-documented educational model for schools to use to implement the technology and access the LANL multimedia server database, based on multiple studies and implementations in a variety of school environments.
- To facilitate high cognitive level learning over the Internet through student-scientist and student-student collaboration at a distance.
- To expand test-area and interactions to a national scope, i.e. include more schools and include out-of-state schools.

FY95 Tasks and Deliverables:

Tasks:

1. C-5 upgrade and increase capacity of multimedia server available for this pilot.
2. C-6, C-5, IS, ACL, and C-3 provide more material for the server.
3. C-5 load the server with the information and make database available to users.
4. C-6 contact schools, set up demo, work with teachers, provide equipment and software needs lists, train local student and teachers on usage, be available for consulting.
5. C-6 and C-8 set up 486 machines locally with the necessary software and hardware to receive the images, set up usage monitoring software.
6. C-6 monitor usage.
7. C-3 and ACL visit schools at prearranged times to assist students with specific projects.
8. C-6 document project; publish.

Deliverables:

1. Demonstrated functionality of Internet accessed multimedia server for education, virtual laboratory, curricular enhancement.
2. Multimedia documentation of what students and teachers did with the new capability.
3. Assessment data from use of the new technology (i.e., evaluation report)

Proposed FY95 Schedule:

Oct. - Dec.: Tasks 1-5

Jan. - May: Tasks 4-7

June- Aug: Task 8

NECESSARY CROSS LINKS::

- Key link is C-5 providing the technical capability to the schools, after it has been fully tested here in larger environment than it is currently used in
- Another key is the connectivity of the schools involved -- we will use schools that already have the high speed internet connection
- Instrumental to the success of this project is the close communication between and the common goals and commitment of C-3, C-5, C-8, the ACL, and C-6. This is a project that requires all five groups to cooperate closely to be successful, and requires a significant amount of patience working with the teachers and students involved.
- The collaboration with IS, SEO, NASA and other targeted contributing sources for educational materials for the server will be strengthened and expanded to provide a strong base of educational and support materials in a variety of media to supplement the research projects, the virtual laboratory experiments, and the communications technologies tested.

Related Laboratory capabilities and investigator's expertise

There are a number of information technology projects that have been started at the Laboratory during the past year. These include the Information Architecture project, the Info2000 project, the Library without Walls project, the DoE Information Infrastructure Initiative. Each has a different emphasis and in each case we have participants of the Sunrise project who are involved in or familiar with each of these. Although the projects do not overlap, we are able to share and exchange information on a regular basis. Another project started this past year is DoE's Gas and Oil National Information Infrastructure project. We have found that many of the technologies being developed in the Sunrise project are immediately applicable to this project. The variety of investigators have considerable expertise in Information Infrastructure technology and its use in technical applications. The data-mining capabilities provided, by C-3, for example, are unmatched anywhere in the country. Dick Phillips, a world-renowned multimedia document expert, is providing the executive user interface technology to these applications.